

12.2.4.6 Implementability. Off-INEEL vendors for chemical stabilization and disposal of D008 and D009 MLLW and hazardous waste were identified. Segmented gate separation of radionuclide-contaminated soils will be evaluated at pilot-scale in 1999. Off-INEEL LLW disposal facilities were also identified.

12.2.4.7 Cost. The estimated cost for this alternative for each site is identified in Table 11-1. The cost analysis for this alternative assumes that no postclosure monitoring or care would be required at any site. The alternative cost estimates are for comparison purposes only and not intended for budgetary, planning, or funding purposes.

12.2.5 Alternative 4: Containment with Institutional Control

This alternative could be applied to any OU 4-13 site of concern. Aspects of the detailed analysis of Alternative 4 specific to individual sites are identified in the discussion below.

12.2.5.1 Overall Protection of Human Health and the Environment. This containment alternative includes institutional controls (radiation surveys, cap integrity monitoring, and access restrictions) and surface water diversion controls. Surface water diversion controls will be maintained at least until the 100-year institutional control period expires. The capped sites and surrounding areas would not accumulate standing water.

The ET-type barrier was designed to isolate low-level radioactive waste land disposal units from human intrusion, contaminant migration and biointrusion, and to provide direct radiation shielding, for 500 to 1,000 years. Some of the redundancy in the basic design was eliminated, since radionuclide risks at CFA-08 will decline to allowable levels within 189 years; and since groundwater protection is not an issue for OU 4-13 sites except for CFA-04 and -10, which are required to meet RCRA requirements. The resulting cover, combined with institutional controls and monitoring, is expected to be highly protective of human health and the environment, and to meet all RAOs, at all OU 4-13 soil release sites of concern.

The ET-type cover would ensure long-term protection by use of natural construction materials approximately 2.9 m (9.6 ft) thick. The thickness of this barrier would be more than sufficient to shield against direct radiation above background levels. The biobarrier component of this design would inhibit biointrusion, thereby protecting ecological receptors. Additionally, this barrier would inhibit inadvertent human intrusion, would divert surface water to perimeter drains, would promote lateral internal drainage and resist wind erosion. Short-term risks to workers and the environment during installation of the engineered cover are low to moderate.

12.2.5.2 Compliance with ARARs and TBCs. Table 12-5 presents the evaluation of the containment alternatives for compliance with ARARs and TBCs. Potential radionuclide and fugitive dust emissions during construction of protective covers at OU 4-13 sites would be controlled through air monitoring and use of dust control as needed. No emissions would be anticipated once a protective cover is in place. Activities associated with the containment alternatives would not constitute an emissions "source" and therefore do not trigger IDAPA 16.01.01.585-586 as an ARAR. The National Emissions Standards for Hazardous Air Pollutants (NESHAP) (40 CFR 61.90) is an ARAR for the containment alternatives, and would be met by eliminating all exposure pathways.

The RCRA-Hazardous Waste Determination rules (40 CFR 262.11) would apply to all sites. Specific provisions of 40 CFR 264.14 (Security) would be considered relevant and appropriate at CFA-04 and -10, and would be met by installing and maintaining signs and fences as needed. The 40 CFR 264.114, "Equipment Decontamination," would be relevant and appropriate and would be met.

Table 12-5. Evaluation of ARARs and TBCs compliance for Alternative 4: Containment and Institutional Controls.

Statute (subject)	Citation	Evaluation		
Action-specific		CFA-04	CFA-08	CFA-10
Idaho Fugitive Dust Emissions	IDAPA 16.01.01.650	ARAR/Yes	ARAR/Yes	ARAR/Yes
NESHAPs for radionuclides from DOE facilities, emission monitoring, and emission compliance	40 CFR 61.92 40 CFR 61.93	ARAR/Yes	ARAR/Yes	ARAR/Yes
	Subpart M-asbestos	ARAR/Yes	Not ARAR	Not ARAR
Hazardous Waste Determination	40 CFR 262.11	ARAR/Yes	ARAR/Yes	ARAR/Yes
Equipment Decontamination	40 CFR 264.114	ARAR/Yes	Not ARAR	ARAR/Yes
Closure and Post Closure	40 CFR 264.310(a)(1-5) 40 CFR 264.310(b)(1, 5, 6)	ARAR /Yes	Not ARAR	ARAR/Yes
Chemical-specific				
Rules for the Control of Air Pollution in Idaho (.210-Demonstration of Preconstruction Compliance with Toxic Standards; .585-Toxic Air Pollutants Non-Carcinogenic Increments; .586-Toxic Air Pollutants Carcinogenic Increments)	IDAPA 16.01.01.210, 16.01.01.585 and 16.01.01.586	ARAR/Yes	ARAR/Yes	ARAR/Yes
Location-specific				
None identified				
TBCs				
Radioactive Waste Management	DOE 5820.2A, Chapter III(3)(a)(1-3)	TBC/Yes	TBC/Yes	Not TBC
Radiation Protection of the Public and the Environment	DOE 5400.5	TBC/Yes	TBC/Yes	Not TBC
Limit of 100 mrem/yr EDE to public from exposures to external and internal radiation sources				
Limit of 10 mrem/yr EDE to the public from airborne doses				
400 mg/kg soil lead cleanup level	OSWER Directive 9355.4-12	Not TBC	Not TBC	TBC/Yes

The RCRA closure and postclosure rules related to closure cover design requirements and cover maintenance (40 CFR 264.310(a)(1-5)) would be relevant and appropriate for CFA-04 and -10, and would be met. These requirements include:

- Provide long-term minimization of the migration of liquids through the closed site
- Function with minimum maintenance
- Promote drainage and minimize erosion or abrasion of the final cover
- Accommodate settling and subsidence so that the cover's integrity is maintained
- Have permeability less than or equal to the permeability of any bottom liner system or natural subsoils present.

The ET-type cover would control infiltration by promoting surface and lateral internal drainage; and by storing infiltrating moisture in the upper vegetated layer, allowing for removal by evapotranspiration. Drainage through the cap would not occur until saturated conditions developed, which would be unlikely. All other ARARs would be met.

The RCRA regulations would not apply to CFA-08, where RCRA listed and/or characteristic wastes are not present. The LDRs would not apply for this alternative for any site, since no wastes would be excavated.

All applicable provisions of DOE orders would be met through the CERCLA RI/FS process, as described previously for Alternative 3. The 400 mg/kg soil lead cleanup level TBC would be met at CFA-10, since all soil contaminated with lead above this concentration would be capped, and the exposure pathway broken. This alternative is therefore considered capable of complying with all ARARs and TBCs identified.

12.2.5.3 Long-term Effectiveness and Permanence. Containment and institutional controls would eliminate the external exposure risk pathway associated with contaminated soils left in place at CFA-08. All other worker, residential and ecological exposure pathways including homegrown produce ingestion, soil ingestion, and biointrusion would also be eliminated by physically restricting access to waste. Cap integrity monitoring and radiation survey programs would be implemented annually for the first 5 years following completion of the cap. The need for further environmental monitoring would be evaluated and determined by the agencies during subsequent 5-year reviews.

The ET-type cap is designed to prevent direct radiation exposures; to inhibit COC exposures due to homegrown produce or soil ingestion; to resist biointrusion that may penetrate the contamination zone and mobilize contaminants in the food chain, or may facilitate erosion due to wind and surface water runoff, and to resist erosion by wind and surface water. The design life of the capping technologies specified for the containment alternatives will depend on the construction materials specified, number and thickness of layers required, sequence of those layers, and construction techniques. The long-term effectiveness and permanence required at OU 4-13 sites is equivalent to the duration of human health and ecological risks. External exposure risks due to Cs-137 calculated for CFA-08 decrease to 1E-04 in approximately 189 years. However, human health and ecological risks due to toxic metals at CFA-04 and -10 do not decrease with time. Long-term effectiveness and permanence required at CFA-04 and -10 is therefore estimated as indefinite, since human health and ecological risks due to toxic metals do not decrease over time.

The ET-type barrier design would provide a high level of biointrusion protection, as evidenced by field-scale studies of similar designs. The ET-type barrier would also provide infiltration control and diversion of precipitation and run-on, which are design requirements at CFA-04 and -10 where RCRA hazardous constituents would remain in place.

The long-term performance of this alternative is considered to be highly effective for controlling all exposure pathways at OU 4-13 soil release sites for 500 to 1,000 years, with minimal maintenance requirements. Cap integrity monitoring, as well as periodic removal of undesirable vegetation and burrowing animals (if necessary), would be performed during the institutional control period.

Erosion and human intrusion are the most likely causes of barrier failure resulting in external exposure to contaminated surface and buried soil. The physical size of the ET-type cover, the thickness of the upper soil layer, the vegetated gravel mulch surface and the coarse texture of the component layers specified in the design are considered to effectively resist erosion. Human intrusion through the cap would be prohibited by land use restrictions.

12.2.5.4 Reduction of Toxicity, Mobility, or Volume through Treatment. No treatment is associated with the containment alternatives.

12.2.5.5 Short-term Effectiveness. Direct radiation exposure of construction workers installing a protective cover would be minimized by first placing a foundation layer over Cs-137 contaminated soils at CFA-08. Emplacement of foundation material and the lowermost layer(s) of the cover would add additional shielding sufficient to eliminate subsequent exposure risks throughout the remainder of construction activities at CFA-08. Based on DOE Order 5480.11, construction activities would be performed in accordance with the ALARA approach to radiation protection.

Inhalation and ingestion risks due to toxic metals in soil at CFA-04 and -10 could be minimized by the use of appropriate PPE, engineering controls, and adherence to health and safety protocols.

Nonexposure risks to workers are also a consideration during construction of the barriers. These risks result primarily from physical construction hazards, such as vehicle accidents or personal injuries. These hazards can be minimized by implementation of appropriate health and safety measures for earth-moving construction activities.

All construction materials for the cap designs are available at the INEEL or within the surrounding communities. Shipment from distant offsite locations is not anticipated to be required. Therefore, no risks are associated with transportation of construction materials.

Environmental impacts resulting from excavation and construction activities would be minimal. Materials would be excavated, transported, and placed entirely within previously disturbed areas. Installation of surface water diversion controls at the sites might alter nearby terrain. However, the overall impact of these activities is not considered irreparable and would be unnoticeable in the long term. The remoteness of the site would prevent any impact to the surrounding communities during construction activities. No environmentally sensitive areas such as archaeological or historical sites, wetlands, or critical habitat exist in the immediate vicinity of the OU 4-13 sites, since all are in previously disturbed areas. All previously undisturbed sites affected by OU 4-13 remedial activities would be evaluated for archeological and ecological resource values prior to disturbance, and activities in sensitive areas would be modified as required to meet ARARs.

The RAOs would be achieved by a containment alternative once construction of the barrier is complete. Approximately 12 to 15 months is assumed for design, procurement, and equipment and personnel mobilization. For the purpose of this FS, and based upon construction schedules for the INEEL OU 5-05/6-01 caps, it is assumed that any barrier can be constructed over any OU 4-13 site within a 6-month period. Administrative, technical, and other personnel would be involved; in addition, approximately 5 to 20 construction workers would be required onsite during construction, depending on the size of the site.

12.2.5.6 Implementability. Institutional controls and surface water diversion controls are easily implementable for this alternative, based on the availability of monitoring, access restriction, and runoff-control technologies. Personnel specifically trained to work in radioactively contaminated areas are available in the communities surrounding the INEEL.

Any future remedial actions required after emplacement of a cover or barrier would be difficult to implement because of the large volume of materials that would be placed over the site. Access into the closed site would likely require complete removal of significant portions of the cover.

Monitoring the effectiveness of containment for preventing external exposure to contaminated surface soil would require only visual inspection to determine the integrity of the barrier. Since infiltration is not a concern, except for CFA-04 and -10, the containment of contaminated surface soil would be ensured as long as the barrier remained intact. However, regular radiation surveys at CFA-08, and cover inspections at all sites, would be performed as part of the institutional controls in order to verify containment. Postclosure monitoring schedules and duration would be addressed during the remedial design phase. Monitoring costs were developed using costs for similar activities at the INEEL provided by LMITCO soil monitoring personnel. Activities were estimated to include:

- Two yearly radiation surveys with a NaI detector around the perimeter and across the surface of the cap at CFA-08
- Two yearly visual inspections at all sites with subsequent maintenance as required
- Annual review
- Five-year review.

12.2.5.7 Cost. The cost estimate developed for this alternative is based on constructing the ET-type cover, installing surface water diversion controls, using monitoring equipment, conducting analyses, and postclosure maintenance and monitoring. The estimated present worth values for constructing and maintaining the engineered cover alternative at OU 4-13 soil release sites are shown in Table 11-1.

Postclosure costs were estimated for the full duration of the 100-year period of maintenance and monitoring. The alternative cost estimates are for comparison purposes only and are not intended for budgetary, planning, or funding purposes.

12.3 Comparative Analysis

The comparative analysis provides a measure of the relative performance of alternatives against each evaluation criterion. The purpose of this comparison is to identify the relative advantages and disadvantages associated with each alternative. The comparative analysis does not identify a preferred alternative, but provides sufficient information to enable this selection by the appropriate decision-makers

(DOE-ID, EPA, and IDHW). The following sections present the alternative comparisons relative to each evaluation criterion, from the perspective of WAG 4. Table 12-6 summarizes how each alternative satisfies the RAOs identified in Section 7.1. Table 12-7 provides a narrative description of the relative performance of each alternative for each evaluation criterion while Table 12-8 summarizes the relative ranking of alternatives.

12.3.1 Overall Protection of Human Health and the Environment

The primary measure of this criterion is the ability of an alternative to achieve RAOs for OU 4-13 sites. For CFA-04 and -10, Alternatives 3a/b (Excavation/Treatment/On- or Off-INEEL Disposal/Institutional Controls, respectively) would provide the most effective long-term protection of human health and the environment, because all contamination above risk-based levels would be removed from the sites to a depth of 3 m (10 ft) bgs, and from the WAG. From the perspective of the WAG, there is no difference in the degree of protection of human health and the environment afforded by Alternatives 3a and 3b. From the perspective of the INEEL, Alternative 3b is significantly more protective, since all waste above human health and ecological risk-based levels would be removed from the INEEL. Alternative 4 is regarded as least effective, since contaminants above PRGs would remain at the sites.

With respect to protection of human health for CFA-08, ex situ treatment would not significantly improve the effectiveness of the remedy relative to removal and disposal alone. Alternative 2 (Institutional Controls) would be least effective, since no engineering controls would be implemented to reduce risks. However, this alternative is still regarded as adequately protective.

For all sites, the containment alternative (Alternative 4) would meet human health and ecological risk RAOs, but is regarded as somewhat less effective than Alternatives 3a and 3b, since contaminants would remain in soils untreated. The ET cover design would provide adequate shielding from direct radiation exposure, and would control all ingestion pathways for human and environmental receptors. Monitoring and maintenance during the institutional control period would control all cover degradation processes, but no controls would be maintained after the end of institutional control. Five-year reviews would be required to ensure that either remedy was still effective, since contaminants would remain in place.

Alternative 1 (No Action with Monitoring) would not prevent exposures resulting in risks greater than $1\text{E-}04$ or HIs greater than 1.0 at sites of concern. This alternative would not meet RAOs at any site, since current workers could be exposed to direct radiation and ingestion risks greater than allowable levels.

12.3.2 Compliance with ARARs

The relative ranking of alternatives with respect to compliance with ARARs is summarized in Table 12-8. For CFA-04 and -10, Alternatives 3a and 3b would best meet all ARARs, since all activities would be completed within approximately 24 months and contaminants would not remain at the sites at levels exceeding risk- or regulatory-based levels. No ARARs related to long-term monitoring or other activities would apply.

Table 12-6. Comparison of alternatives with RAOs.

Criteria	Alternative 1: No Action with Monitoring (all sites)	Alternative 2: Institutional Controls (CFA-08 only)	Alternative 3a: Excavate/ Treat/ICDF Disposal (all sites)	Alternative 3b: Excavate/ Off-INEEL Treatment and Disposal (all sites)	Alternative 4: Containment w/ET-type Cap (all sites)
RAOs for contaminated soil					
Inhibit exposure	No additional exposure prevention provided.	Eliminates potential exposure by restricting access for duration of risk	Eliminates potential exposure by removing contamination from site.	Eliminates potential exposure by removing contamination from site.	Exposure prevented by thick protective cover.
Inhibit ingestion	No additional ingestion prevention provided.	Eliminates potential exposure by restricting access for duration of risk	Eliminates potential ingestion by removing contamination from site.	Eliminates potential ingestion by removing contamination from site.	Ingestion prevented by isolating contamination beneath a protective cover.
Inhibit degradation of closure covers	No protection provided.	NA	NA	NA	Protection provided for 100-year institutional control period.
Inhibit exposures to ecological receptors	No additional control of environmental exposure to contaminated soil.	No ecological risks identified	Eliminates potential exposure by removing contamination from site.	Eliminates potential exposure by removing contamination from site.	Protection provided by isolating contamination beneath a protective cover.

Table 12-7. Detailed analysis summary for OU 4-13 sites.

Criteria	Alternative 1: No Action with Monitoring (All sites)	Alternative 2: Institutional Controls (CFA-08 only)	Alternative 3a: Excavate/treat/ ICDF Disposal (All sites)	Alternative 3b: Excavate/treat/ Off-INEEL Disposal (All sites)	Alternative 4: Containment w/ET-type Cover (All sites)
Overall Protection of Human Health and the Environment					
Human health protection	No reduction in risk.	Eliminates potential exposure by restricting access for duration of risk	Eliminates potential exposure from contaminated soil at site by completely removing contamination from WAG 4. From WAG 4 perspective, no additional protection afforded by treatment.	Eliminates potential exposure from contaminated soil at site by completely removing contamination from WAG 4. From WAG 4 perspective, no additional protection afforded by treatment.	Cap would prevent exposure to contaminated soil and debris for 500–1,000 years.
Environmental protection	Allows continued ecological exposures.	No ecological risk identified for CFA-08	Eliminates potential ecological exposures by completely removing contamination from site. From WAG 4 perspective, no additional ecological protection afforded by treatment.	Eliminates potential ecological exposures by completely removing contamination from site. From WAG 4 perspective, no additional ecological protection afforded by treatment.	Cap would prevent exposure to contaminated soil and debris for 500–1,000 years.
Idaho Fugitive Dust Emissions-IDAPA 16.01.01650 et seq.	Would not meet ARAR because no controls would be implemented	Would not meet ARAR because no controls would be implemented	Would meet ARAR by eliminating potential for windblown soil contamination.	Would meet ARAR by eliminating potential for windblown soil contamination.	Would meet ARAR by eliminating potential for windblown soil contamination.
NESHAPS-40 CFR 61.92	NA	NA	Would meet ARAR by eliminating all exposure pathways.	Would meet ARAR by eliminating all significant exposure pathways.	Would meet ARAR by controlling all exposure pathways.
Hazardous Waste Determination-40 CFR 262.11	NA	NA	Would meet ARAR.	Would meet ARAR.	Would meet ARAR.
Security-40 CFR 264.14	NA	NA	NA	NA	Would meet ARAR for CFA-04 and -10; not ARAR for CFA-08.
Equipment Decontamination-40 CFR 264.114	NA	NA	Would meet ARAR for CFA-4 and -10; not ARAR for CFA-08.	Would meet ARAR for CFA-04 and -10; not ARAR for CFA-08.	Would meet ARAR for CFA-04 and -10; not ARAR for CFA-08.
Closure and Post-Closure-40 CFR 264.310(a)(1-5), 264.310(b)(1,5,6)	NA	NA	NA	NA	Would meet ARAR for CFA-04 and -10; not ARAR for CFA-08.
Use and Management of Containers-40 CFR 264 Subpart I	NA	NA	ARAR-would be met for CFA-04 and -10; not ARAR for CFA-08.	ARAR-would be met for CFA-04 and -10; not ARAR for CFA-08.	NA

Table 12-7. (continued).

Criteria	Alternative 1: No Action with Monitoring (All sites)	Alternative 2: Institutional Controls (CFA-08 only)	Alternative 3a: Excavate/treat/ ICDF Disposal (All sites)	Alternative 3b: Excavate/treat/ Off-INEEL Disposal (All sites)	Alternative 4: Containment w/ET-type Cover (All sites)
Miscellaneous Units – 40 CFR 264.601, 264.602	NA	NA	ARAR-would be met for CFA-04 and –10; not ARAR for CFA-08.	ARAR-would be met for CFA-04 and –10; not ARAR for CFA-08.	NA
Land Disposal Restrictions-40 CFR 268.40, .45, .48	NA	NA	ARAR-would be met for CFA-04 and –10; not ARAR for CFA-08.	ARAR-would be met for CFA-04 and –10; not ARAR for CFA-08.	NA
Rules for the Control of Air Pollution in Idaho-IDAPA 16.01.01.210, 16.01.01585 and 16.01.01586	NA	NA	ARAR-would meet through use of engineering controls.	ARAR-would meet through use of engineering controls.	ARAR-would meet through use of engineering controls.
Radioactive Waste Management-DOE 5820.2A	NA	Would meet TBC through administrative controls restricting access.	Would meet TBC through use of administrative and engineering controls. Not TBC for CFA-10.	Would meet TBC through use of administrative and engineering controls. Not TBC for CFA-10.	Would meet TBC through use of administrative and engineering controls. Not TBC for CFA-10.
Radiation Protection of the Public and Environment-DOE 5400.5	Would not meet TBC at CFA-04, -08 because no controls would be implemented. Not TBC for CFA-10.	Would meet TBC through administrative controls restricting access.	Would meet TBC through use of administrative and engineering controls. Not TBC for CFA-10.	Would meet TBC through use of administrative and engineering controls. Not TBC for CFA-10.	Would meet TBC through use of administrative and engineering controls. Not TBC for CFA-10.
Soil lead cleanup level-OSWER 9355.4-12	Not TBC for CFA-04, -08. Would not meet TBC for CFA-10	Not TBC	Not TBC for CFA-04, -08. Would meet TBC for CFA-10 by removing all soil above action levels.	Not TBC for CFA-04, -08. Would meet TBC for CFA-10 by removing all soil above action levels.	Not TBC for CFA-04, -08. Would meet TBC for CFA-10 by eliminating exposure pathway.
Magnitude of residual risk	No change from existing risks.	Risk eliminated by administrative controls on access.	Source-to-receptor pathways eliminated by removing source.	Source-to-receptor pathways eliminated by removing source.	Source-to-receptor pathways eliminated while cap remains in place.
Adequacy and reliability of controls	No control and, therefore, no reliability.	Reliable for duration of risk.	Disposal facility is assumed to provide adequate and reliable control over disposed soil and debris for the period of institutional controls.	Disposal facility is assumed to provide adequate and reliable control over disposed soil and debris for the period of institutional controls.	Barrier estimated to provide control over contaminated soil for at least 500-1,000 years.
Treatment process used	NA	NA	Chemical stabilization, segmented gate separation.	Chemical stabilization, segmented gate separation	Not applicable.
Amount destroyed or treated	NA	NA	None destroyed; approximately 100% treated.	None destroyed; approximately 100% treated.	Not applicable.

Table 12-7. (continued).

Criteria	Alternative 1: No Action with Monitoring (All sites)	Alternative 2: Institutional Controls (CFA-08 only)	Alternative 3a: Excavate/treat/ ICDF Disposal (All sites)	Alternative 3b: Excavate/treat/ Off-INEEL Disposal (All sites)	Alternative 4: Containment w/ET-type Cover (All sites)
12-21 Reduction of toxicity, mobility, or volume	NA	NA	Segmented gate separation – greater than 90% volume reduction; chemical stabilization-200% volume increase. Greater than 90% mobility reduction. No reduction in COC toxicity.	Segmented gate separation –greater than 90% volume reduction; chemical stabilization-200% volume increase. Greater than 90% mobility reduction. No reduction in COC toxicity.	NA
Irreversible treatment	NA	NA	Chemical stabilization and segmented gate separation are not considered irreversible.	Chemical stabilization and segmented gate separation are not considered irreversible.	NA
Type and quantity of residuals remaining after treatment	NA	NA	Chemical stabilization-stabilized soils, decontamination fluids; discarded PPE. Segmented gate-contaminated soil, decontamination fluids, discarded PPE.	Chemical stabilization-stabilized soils, decontamination fluids; discarded PPE. Segmented gate-contaminated soil, decontamination fluids, discarded PPE.	NA
Statutory preference for treatment	Does not meet preference.	Does not meet preference	Meets preference.	Meets preference.	Does not meet preference.
Community protection	No increase in potential risks to the public.	No increase in potential risks to the public.	No increase in potential risks to public.	Slight increase in potential risks to the public during offsite transportation.	No increase in potential risks to the public.
Worker protection	Not applicable.	Workers protected by administrative controls	Workers protected by administrative and engineering controls.	Workers protected by administrative and engineering controls.	Workers protected by administrative and engineering controls.
12-21 Environmental impacts	No change from existing conditions.	No change from existing conditions.	Limited to disturbances from vehicle and material transport activities associated with excavation and transportation. Limited potential for airborne contamination in the form of fugitive dust, due to use of water sprays.	Limited to disturbances from vehicle and material transport activities associated with excavation and transportation. Limited potential for airborne contamination in the form of fugitive dust, due to use of water sprays.	Limited to disturbances from vehicle and material transport activities associated with barrier construction. Limited potential for airborne contamination in the form of fugitive dust, due to use of water sprays.
Time until action is complete	Not applicable.	Completed in 189 years, when Cs-137 levels at CFA-08 decay to unrestricted release criterion.	Approximately 18 to 24 months.	Approximately 18 to 24 months.	Approximately 18 to 24 months.

Table 12-7. (continued).

Criteria	Alternative 1: No Action with Monitoring (All sites)	Alternative 2: Institutional Controls (CFA-08 only)	Alternative 3a: Excavate/treat/ ICDF Disposal (All sites)	Alternative 3b: Excavate/treat/ Off-INEEL Disposal (All sites)	Alternative 4: Containment w/ET-type Cover (All sites)
Ability to construct and operate	No construction or operation.	No construction or operation.	ICDF status uncertain. Moderately difficult to construct and operate, involves available excavation and transportation equipment, specialized treatment equipment.	Moderately difficult, involves available excavation and transportation equipment, specialized treatment equipment.	Involves available construction technology.
Ease of implementing additional action if necessary	May require repeat of feasibility study/record of decision process.	Easy	Additional remedial action would not be necessary, as all contaminated soil and debris are removed.	Additional remedial action would not be necessary, as all contaminated soil and debris are removed.	Additional remedial actions would be difficult, as the barrier is intended to prevent access to contamination. Barrier would require removal.
Ability to monitor effectiveness	Monitoring of conditions is readily implemented.	Monitoring of conditions is readily implemented.	The effectiveness in removing all contaminated materials associated with site is easily monitored; effectiveness in treatment more difficult, requires confirmation sampling and analysis.	The effectiveness in removing all contaminated materials associated with site is easily monitored; effectiveness in treatment more difficult, requires confirmation sampling and analysis.	Barrier performance can be monitored through radiation surveys, can be visually assessed on the basis of physical integrity.
Ability to obtain approvals and coordinate with regulatory agencies	No approvals required.	No approvals required.	Moderately difficult.	Moderately difficult.	Moderately difficult.
Availability of services and capacity	None required.	None required.	Services available either onsite or through subcontractor. ICDF status uncertain, projected to exist on INEEL by 2001. Treatment services available through subcontractors	Services available either onsite or through subcontractor. Treatment and disposal capacity exists offsite.	Barrier design and services reside within the DOE and are considered readily available to INEEL.
12-22 Availability of equipment, specialists, and materials	None required	None required.	Equipment and materials are either available onsite, through subcontractors or will be purchased.	Equipment and materials are either available onsite, through subcontractors or will be purchased.	Equipment and materials are readily available at the INEEL or within the surrounding community.
Availability of technology	None required.	None required.	Readily available at the INEEL and/or through subcontractors.	Readily available at the INEEL and/or through subcontractors.	Readily available at the INEEL.
Costs	See Table 11-1	See Table 11-1	See Table 11-1	See Table 11-1	See Table 11-1

Table 12-8. Relative ranking of OU 4-13 site grouping remedial alternatives with respect to CERCLA evaluation criteria.^a

Evaluation Criteria	Radionuclide-Contaminated Site (CFA-08)	RCRA Hazardous Waste Sites (CFA-04, -10) ¹
Overall protection of human health and the environment	(3a, 3b), 4, 2 1 does not meet the criterion	(3a, 3b), 4 1 does not meet the criterion
Compliance with ARARs	2, (3a, 3b), 4 1 does not meet the criterion	(3a, 3b), 4 1 does not meet the criterion
Long-term effectiveness and permanence	(3a, 3b), 4, 2, 1	(3a, 3b), 4, 1
Reduction of toxicity, mobility or volume through treatment	(3a, 3b), (4, 1, 2)	(3a, 3b), (4, 1)
Short-term effectiveness	1, 2, 4, (3a, 3b)	1, 4, (3a, 3b)
Implementability	1, 2, 4, 3a, 3b	1, 4, 3a, 3b
Cost	1, 2, 4, 3a, 3b	CFA-04: 1, 3a, 4, 3b CFA-10: 1, 3a, 3b, 2, 4

a. Ranking is from highest to lowest, except for costs, which are ranked from lowest to highest in net present value.

() = No significant difference between alternatives with respect to the criterion.

Alternative 1: No Action With Monitoring.

Alternative 2: Institutional Controls

Alternative 3a: Excavate, Treat, and ICDF Disposal and Institutional Controls.

Alternative 3b: Excavate, Treat and Off-INEEL Landfill Disposal and Institutional Controls

Alternative 4: Containment with ET-Type Cover.

For CFA-08, Alternative 2 would best meet ARARs, since no active remediation would be implemented. Containment (Alternative 4) would meet ARARs least effectively at all sites, since active management would be required during the institutional control period to meet RCRA requirements at CFA-04 and -10; and DOE Orders at CFA-08.

Alternative 1 (No Action with Monitoring) would not involve construction or operation activities, therefore ARARs specific to these activities would not apply. However, IDAPA 16.01.01.650, the Fugitive Dust Control ARAR, could apply to OU 4-13 sites, regardless of whether or not remedial construction and/or operations occur, and would not be met by the No Action with Monitoring alternative. If toxic metals or organics were present in the fugitive dust, then IDAPA 16.01.01.210, 16.01.01.585 and 16.01.01.586 are ARARs that would not be met because no controls would be implemented.

The DOE orders limiting exposures to workers and hypothetical future residents would not be met in the absence of controls at CFA-08. The OSWER Directive for lead cleanup level would not be met for CFA-10.

12.3.3 Long-term Effectiveness and Permanence

Alternatives 3a and 3b would provide equivalent high long-term effectiveness and permanence, because contaminated soil and debris would be removed from the WAG. No long-term reliance on engineering or administrative controls would be required at the individual sites if all soil contaminated above PRGs was removed.

Alternative 4 would be less effective and permanent, and would also require monitoring, maintenance, and 5-year reviews during the institutional control period. Alternative 1 (No Action with Monitoring) would provide the least possible level of long-term effectiveness and permanence, based on the residual risk associated with OU 4-13 sites identified in the BRA.

For CFA-08, Alternative 2 would be less effective than Alternative 4, since no engineering controls on exposures would be implemented. However, the institutional controls that would be implemented are regarded as adequately protective.

12.3.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Only Alternatives 3a and 3b would apply treatment to contaminated OU 4-13 soils, therefore these alternatives have the highest rating with respect to this criterion. Alternatives 3a and 3b would reduce mobility and/or volume, however toxicity of radionuclides and metals would not be reduced. Volume could potentially be reduced by as much as 90% for segmented gate soil sorting, however mobility would not be reduced. Stabilizing soils in Portland cement would increase volumes of contaminated material by as much as 200%. Mobility would be eliminated completely through stabilization in Portland cement, assuming the process was carefully implemented and monitored.

Alternatives 1, 2 and 4 are equivalent with respect to this criterion, since no treatment would be implemented.

12.3.5 Short-term Effectiveness

Alternative 1 (No Action with Monitoring) would be the most effective alternative in the short-term at all sites, since no actions resulting in additional worker exposures would occur. None of the OU 4-13 sites are located near inhabited areas and no public roads are in the vicinity, therefore no offsite exposures would occur. No additional environmental impacts would result from this alternative other than the conditions already existing. Potential contaminant migration from surface soil exists in the form of wind and water erosion. As noted previously, the BRA indicates that the No Action with Monitoring alternative would not meet RAOs, due to existing worker and ecological risks.

For CFA-08, Alternative 2 would provide the highest short-term effectiveness, since no active remediation would be implemented that could result in worker exposures.

Alternative 4 would provide effective short-term protection at all sites. Exposure risks to workers during cover construction would be minimal. Personal protective equipment and adherence to health and safety protocols would minimize exposures during consolidation activities. Initial foundation layers would likely provide sufficient shielding to reduce direct exposure to workers to acceptable levels.

Ecological impacts resulting from excavation of cover materials including soil, basalt, gravel, and cobbles would be assumed to be minimal, since previously utilized sources for all of these materials exist on the INEEL. The RAOs would be achieved with the containment alternatives after cover construction

was complete. Fill material placed as a cap foundation would prevent contaminant migration to the surrounding environment in addition to providing shielding for workers.

Alternatives 3a and 3b would be less effective for short-term protection for CFA-08. The risk to workers resulting from direct exposure to the contaminated soil and debris is considered significant. Environment impacts would be minimized by maintaining dust suppression controls during excavation, treatment and transportation. Additionally, some increase in potential risk to the public from exposure to contaminated materials, in the event of a transportation accident, would likely result.

The relative ranking of the alternatives with respect to short-term effectiveness is shown in Table 12-8.

12.3.6 Implementability

Alternative 1 (No Action with Monitoring) would be most implementable for all sites, since it would require no change in existing site conditions. Alternative 2 would be very implementable for CFA-08, since no active remediation would be implemented and the only additional action required would be to implement deed restrictions. The containment alternative (Alternatives 4) design is relatively simple and has been constructed on the INEEL at pilot-scale.

Alternative 3a is more technically implementable than 3b, because of the shorter transportation distance. The individual treatment technologies specified for Alternatives 3a and 3b are available and have been demonstrated. Alternative 3a would require significantly more resources to perform environmental assessments, safety analyses, and permit applications than Alternative 3b. If the ICDF or other INEEL disposal facilities were not available, Alternatives 3b would be more implementable than Alternatives 3a.

The relative ranking of the alternatives with respect to implementability is shown in Table 12-8.

12.3.7 Cost

The relative ranking of the alternatives for all site groupings with respect to present worth cost is presented in ascending order in Table 12-8. The level of detail used to develop the cost estimates presented is considered appropriate for comparing alternatives. Separate cost line items are developed for the primary components of each remedial action alternative, such as monitoring; capping; excavation; disposal, and reporting requirements such as RD/RA scope of work, RD/RA work plans, safety documentation, and progress reports.

The level of detail presented in the cost estimates is consistent with the level of detail provided in the descriptions of each alternative. Additional details in the cost estimates are not considered appropriate without supporting detailed designs for each alternative. The uncertainty associated with each cost estimate increases with the complexity of the alternative.

The No Action alternative (Alternative 1) was estimated to be the least expensive for CFA-04. Containment onsite (Alternative 4) was estimated as more expensive, but not significantly so, than excavation/treatment/ICDF disposal (Alternative 3a) for CFA-04; while Alternative 4 was more expensive than any other alternative for CFA-10, reflecting economy of scale for capping. Excavation/treatment/offsite disposal (Alternative 3b) was significantly more expensive than any other alternative considered for CFA-04.

The No Action alternative (Alternative 1) was estimated to be the least expensive for CFA-08. Institutional control (Alternative 2) was estimated to be significantly less expensive than any other remedial alternative for CFA-08, while Containment (Alternative 4) was significantly less expensive than any other active remediation alternative considered for CFA-08. Excavation/treatment/ICDF disposal (Alternative 3a) was estimated as about three times more expensive than containment onsite. ICDF disposal (Alternative 3a) was estimated to be less expensive than offsite disposal (Alternative 3b).

12.4 Summary of the Comparative Analysis

In general, the contaminant types and site characteristics at OU 4-13 are similar to those encountered elsewhere on the INEEL. Remedial technologies and alternatives identified to control or eliminate risks to human health and the environment at OU 4-13 are those previously demonstrated at the INEEL, or under similar conditions elsewhere. The intent of the FS is to provide risk managers sufficient information on various technologies and alternatives to prepare the proposed plan and the ROD. Technologies used to formulate alternatives are regarded only as representative; risk managers may combine other technologies identified in this report as effective and technically implementable, to formulate different alternatives.

Human health risks at all sites will persist beyond the 100-year institutional control period; therefore, monitoring/institutional controls alone (Alternative 1) will not meet RAOs and does not meet the threshold criteria. Alternative 2 (Institutional Controls) is regarded as protective only for CFA-08, where no ecological risks were identified. Alternatives that would remove all soil contaminated above PRGs from the WAG (Alternatives 3a and 3b) are regarded as equivalent in providing highly effective protection of human health and the environment for all sites.

Alternatives incorporating ex situ treatment were not determined to provide significantly more long-term effectiveness and permanence, or protection of human health, than removal and disposal alone; and they are more expensive. Treatment would only be required for RCRA characteristic wastes excavated from CFA-04 and -10. Mobility and volume of radionuclides and toxic metals could be reduced through treatment; however, in general OU 4-13 contaminants are dispersed in soil and containment, either onsite or offsite, is appropriate, based on expectations for remedial actions cited in 40 CFR 300.430.

Institutional Control (Alternative 2) was identified as the least expensive alternative that would meet the threshold evaluation criteria for the largest OU 4-13 site, CFA-08. The long-term effectiveness and permanence of this alternative was estimated as adequate, but lower than combined engineering and administrative controls.

For CFA-04 and -10, excavation, treatment and ICDF disposal (Alternative 3a) was estimated as the least expensive alternative that would meet the threshold criteria.

12.5 References

- Anderson, J. E., et al., 1987, "Control of Soil Water Balance by Sagebrush and Three Perennial Grasses in a Cold-desert Environment," *Arid Soil Research and Rehabilitation* 1, pp. 229-244.
- EPA, 1988, *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*, EPA/540/G-89/004, Interim Final, U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, October.

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